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# RPPR Final Report

as of 23-Oct-2017

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**STEM Participants:** 14

**Major Goals:** The main goal of our research was to advance the understanding of social status by using neuropsychological insights and methods (EEG and fMRI) to test predictions generated from status characteristics theory (Berger et al. 1977). In line with two separate studies that we conducted, there are two specific sub-goals linked to our main goal.

First, in Study 1 we used EEGs to test predictions about what happens, neurologically, where a teammate/group member acts, or fails to act, in a manner consistent with her or his social status.

And second, in Study 2 we used fMRI to test predictions about patterns of brain activation in collective task situation involving a higher- or lower-status partner--i.e., the kinds of situations to which status characteristics theory applies.

Taken together, both studies advance our understanding of how "rank" operates in task settings, such as those encountered everyday in military contexts.

**Accomplishments:** Both of the studies that we proposed to complete were completed.

For Study 1, we successfully collected data for the proposed 2 x 2 factorial design with the proposed number of participants (20) in each of the four conditions. The conditions can be ordered according to the extent to which the participant's (simulated) partner behaves in a counter-normative way vis-a-vis the participant's manipulated relative status.

We have recently refined the theoretical argument presented in our original proposal by drawing on Wagner's (1988) theory of status deviance. As Wagner argued, "Because of the position the high-status deviant occupies in the group, that actor may have greater freedom to deviate from group norms...[H]igh-status deviance may include such actions as...exercising less influence in the group's discussion...[L]ow-status deviance is likely to include... attempting to exercise more influence over the group...[L]ow-status deviance is likely to be identified as a status violation much more quickly than is high-status deviance" (p. 119).

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Based on the refined arguments, and with reference to the proposed design, Condition 4 involves the most counter-normative behavior by the simulated partner: the participant is higher status (i.e., is demonstrably more competent), but the lower status/less competent partner behaves obstinately--stubbornly and repeatedly rejecting input from the participant. This is the most egregious situation. It is similar to an enlisted soldier disobeying orders.

Condition 1 also involves counter-normative behavior by the partner, but the situation is less egregious: the participant is lower status (less competent), but the higher status/more competent partner repeatedly ACCEPTS input from the participant. Thus this condition involves what Wagner calls "high-status deviance." It is equivalent to an officer being influenced "too much" by enlisted soldiers, which can call leadership into question.

Conditions 2 and 3 are normative situations and thus should create the least "offense." In Condition 2, the participant is higher status/more competent, and the lower status/less competent partner does what s/he SHOULD do--i.e., the partner repeatedly accepts input/influence from the (higher status/more competent) participant. And in Condition 3, the participant is lower status/less competent, and the higher status/more competent partner repeatedly rejects input from the (lower status/less competent) partner, as should be the case based on relative rank.

So, in terms of degree of "expectancy violation," the conditions can be ordered as follows from greatest violation to least violation:  $4 > 1 > (2 = 3)$ .

Our paradigm provided 20 opportunities (trials) for participants to "observe" the (simulated) partner's behavior. On each trial, participants made a private binary choice about an ambiguous problem. They then saw the partner's supposed choice--always rigged to be different on the 20 trials of interest. Participants then had an opportunity to make a final choice. They were led to believe that their partner was doing the same. Finally, participants got to see whether the partner ended up changing their initial answer (influenced) or staying with it (rejection of influence).

So, the main events in our paradigm are: initial choice, feedback, final choice, and partner behavior.

For our main analysis we created short, 1-second EEG segments around the 20 "partner behavior" events across the 20 trials. We then performed an event-related potential (ERP) analysis by first averaging the 20 segments for each participant. We then grand-averaged them by condition. For this analysis, we focused on the "feedback-related negativity" (FRN) ERP, which is a negative peak/deflection that occurs 200-300 ms post-stimulus and is known to encode social expectancy violation (Sun and Yu 2014).

So, if status-based expectations order interaction the way we think they do according to status characteristics theory (Berger et al. 1977) along with Wagner's (1988) theory of status deviance, then the FRN should increase in amplitude as the degree of status deviance increases, in line with our ordinal prediction-- i.e.,  $4 > 1 > (2 = 3)$ .

The results are strong. In the general linear model (GLM) framework, an omnibus test of the effect of condition (1-4) on the FRN is highly significant ( $F = 6.737$ ,  $p = .000$ ). Planned contrasts confirm the predicted ordering,  $4 > 1 > (2 = 3)$ . As expected, the FRN for Condition 4 is significantly greater than it is for Condition 1 ( $t = 2.078$ ,  $p = .041$ ); the FRN for Condition 1 is significantly greater than it is for the average of conditions 2 and 3 ( $t = 2.078$ ,  $p = .042$ ); and the FRN for Condition 2 is not different from the FRN for Condition 3 ( $t = .104$ ,  $p = .918$ ). Because the p-value for the difference between conditions 2 and 3 is greater than .5, we can safely assume that the FRN means for these two conditions are actually equivalent (Frick 1995).

Though not originally proposed, based on results associated with our second study (discussed below), we also conducted a mediation analysis. Past research has shown that reduced/lower power in the EEG alpha band (8-12 Hz) is associated with confidence in an impending choice (Kubaneck et al. 2015). So, we reasoned that because higher status actors are expected to be more competent, they should have more confidence in their initial choices for the 20 ambiguous task problems. Thus we tested this prediction: does alpha power--as an indicator of confidence in initial decisions on task problems--mediate the effect of manipulated status on influence? If it does, this would further, and perhaps more strongly, establish that status-based expectations play the role we think they play in status processes.

For this analysis, we computed EEG alpha power for segments created around each of the participant's 20 initial choices. We then looked at whether the effect of status (the manipulated independent variable) on whether the participant "stayed" with her/his initial answer (the repeated dichotomous outcome, rejection of influence) is

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mediated by EEG alpha power (the repeated continuous mediator). We decomposed the total effect of status into direct and indirect effects using the KHB method (Karlson, Holm, and Breen 2011) with the GEE option. The indirect effect of status on influence through EEG alpha power is significant ( $p = .015$ ); however, only 2.5% of the effect of status is transmitted through alpha power. While this is a ground-breaking finding within the tradition of status characteristics theory (i.e., because it has long been believed that latent status expectations could never be translated into observable states), the small size of the mediation effect suggests that we need to consider other (better) mediators.

We conducted the EEG mediation analysis because we did not find evidence of mediation in our second (fMRI) study. We completed Study 2 as planned, but the results were not as clear. As we did in Study 1, in Study 2 we used the same basic task and attempted to measure status-based expectations "on the fly" using fMRI. Here, though, we employed a within-subjects design (i.e., each participant had three partners: lower, equal, and higher status). In this paradigm, the specific partner was identified for four seconds at the start of each trial, and this is when we collected the BOLD measurement within several regions of interest (ROIs). Unfortunately, for these data, the effect of manipulated status on influence is NOT mediated by any of the BOLD measures. That said, we have already published a paper for Study 2 (see Dissemination section). We conclude in that paper that we need better, clearer fMRI-based measures of status-based expectations. The paper also lays the groundwork for a paper based on Study 1, which has much stronger results (as described above). A paper based on Study 1 is "in prep" and will be submitted in the next several months.

**Training Opportunities:** Our projects provided training opportunities for a post-doctoral fellow (Dr. Joshua Pollock), seven undergraduate students (Charles Campana, Mercy Coffman, Megan Downey, Timothy Elder, James Moore, Sharon Nichols, and Steven Raap), and seven graduate students (Siqi Han, Ryan Lackner, Kelly Markowski, Brenna Miller, Jonathan Overton, Matthew Pfeiffer, and Victoria Reynolds).

The post-doctoral fellow was involved with data collection, data processing, and data analysis. He also oversaw the training of all student assistants in EEG methods. The undergraduate students were involved with participant recruitment, the consent process, administering experimental sessions, and managing data. Finally, the graduate students were involved with participant recruiting and scheduling, the consent process, administering experiments, managing data, and analyzing data.

One of the graduate students, Siqi Han, authored a paper with us for our second (fMRI) study (see Dissemination section). The post-doctoral fellow (Dr. Joshua Pollock) and three graduate students (Matthew Pfeiffer, Brennan Miller, and Jonathan Overton) gave a presentation with us and are authors on a paper for Study 1 that is currently "in prep" (see Dissemination section).

**Results Dissemination:** We published one peer-revised paper so far based on Study 2:

Melamed, David, Will Kalkhoff, Siqi Han, and Xiangrui Li. 2017. "The Neural Bases of Status-Based Influence." *Socius: Sociological Research for a Dynamic World*. DOI: <https://doi.org/10.1177/2378023117709695>

A paper based on Study 1 is currently "in prep." It will be submitted to the *American Sociological Review* within the next several months:

Kalkhoff, Will, David Melamed, Joshua Pollock, Matthew Pfeiffer, Brennan Miller, and Jonathan Overton. In prep. "In Search of Expectations."

We have given one refereed presentation so far based on both studies:

Kalkhoff, Will, David Melamed, Joshua Pollock, Matthew Pfeiffer, Brennan Miller, and Jonathan Overton. 2017. "In Search of Expectations." 29th Annual Group Processes Conference, Montreal, Quebec, Canada.

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**PARTICIPANTS:**

**Participant Type:** Postdoctoral (scholar, fellow or other postdoctoral position)

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**Person Months Worked:** 12.00

**Funding Support:**

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

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**Person Months Worked:** 12.00

**Funding Support:**

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

**Participant Type:** Graduate Student (research assistant)

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**Person Months Worked:** 12.00

**Funding Support:**

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

**Participant Type:** Graduate Student (research assistant)

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**Person Months Worked:** 12.00

**Funding Support:**

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

**Participant Type:** Graduate Student (research assistant)

**Participant:** Brennan Miller

**Person Months Worked:** 12.00

**Funding Support:**

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

**Participant Type:** Graduate Student (research assistant)

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**Person Months Worked:** 12.00

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**Person Months Worked:** 12.00

**Funding Support:**

Project Contribution:

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National Academy Member: N

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**Funding Support:**

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International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

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**Funding Support:**

Project Contribution:

International Collaboration:

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National Academy Member: N

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**Funding Support:**

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

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Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

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National Academy Member: N  
Other Collaborators:

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**Funding Support:**

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International Travel:

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Other Collaborators:

**Participant Type:** Undergraduate Student

**Participant:** Sharon Nichols

**Person Months Worked:** 12.00

**Funding Support:**

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

**Participant Type:** Undergraduate Student

**Participant:** Steven Raap

**Person Months Worked:** 12.00

**Funding Support:**

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

**Participant Type:** Co PD/PI

**Participant:** David Melamed

**Person Months Worked:** 12.00

**Funding Support:**

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

**Participant Type:** PD/PI

**Participant:** Will Kalkhoff

**Person Months Worked:** 12.00

**Funding Support:**

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International Collaboration:

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Other Collaborators:

**Participant Type:** Technician

**Participant:** Xiangrui Li

**Person Months Worked:** 12.00

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"Nothing to report in the uploaded pdf (see accomplishments)"